40. (Amended) A catalyst having activity under an irradiation of visible light in a wavelength region from about 400 to 600 nm, comprising titanium dioxide having stable oxygen defects and exhibiting NOx oxidation activity under the irradiation of a visible light at least in the wavelength region of from about 400 to 600 nm.

41. (Amended) The catalyst according to claim 40, wherein said titanium dioxide component comprises titanium dioxide of an anatase type or a rutile type.

42. (Amended) The catalyst according to claim 40, wherein the titanium dioxide has a primary particle size of 10 nm or less in diameter.

43. (Amended) The catalyst according to Claim 40, comprising titanium dioxide that is characterized by an X-ray diffraction (XRD) pattern that is substantially free from patterns other than those patterns assigned to anatase type titanium dioxide.

44. (Amended) A catalyst having activity under an irradiation of visible light, said catalyst comprising titanium dioxide having stable oxygen defects and a peak area ratio (O1s/Ti2p) of a peak area obtained by X-ray photoelectron spectroscopy assigned to the 1s electrons of oxygen (O1s) participating in the bonds with titanium to the peak area obtained by X-ray photoelectron spectroscopy assigned to the 2p electrons of titanium (Ti2p) is 1.99 or lower.

45. (Amended) The catalyst according to claim 44, wherein said peak area ratio (O1s/Ti2p) is in a range of from 1.5 to 1.95.

46. (Amended) The catalyst according to claim 44, wherein said peak area ratio (O1s/Ti2p) remains substantially constant for time durations of 1 week or longer.

47. (Amended) A catalyst having activity under an irradiation of visible light, the catalyst comprising titanium dioxide having stable oxygen defects and yielding a signal having a g value of from 2.003 to 2.004 in the ESR measured in darkness at 77K under vacuum, and the catalyst also yielding a signal higher in intensity when measured at least under the irradiation of light in the wavelength region of from 420 to 600 nm at 77K in vacuum.

49. (Amended) A catalyst having activity under an irradiation of a visible light, characterized in that said catalyst is an oxide semiconductor having stable oxygen defects selected from the group consisting of hafnium oxide, zirconium oxide, strontium titanate, titanium oxide-zirconium oxide based complex oxides, and silicon oxide-titanium oxide based complex oxides.

50. (Amended) A method for producing a catalyst comprising an oxide semiconductor having stable oxygen defects and having activity under an irradiation of a visible light, said method comprising treating the oxide semiconductor with hydrogen plasma, characterized by performing said treatment in a state substantially free from an intrusion of air into a treatment system.

51. (Amended) The method for producing a catalyst according to claim 50, wherein said treatment is performed in a tightly sealed system and said state substantially free

from the intrusion of air into the treatment system is a state in which the vacuum degree inside the tightly sealed system takes at least 10 minutes to make a change of 1 Torr.

52. (Amended) The method for producing a catalyst according to claim 50, wherein said oxide semiconductor is selected from the group consisting of titanium dioxide, zirconium oxide, hafnium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, and a silicon oxide-titanium oxide based complex oxide.

53. (Amended) A method for producing a catalyst comprising an oxide semiconductor having stable oxygen defects and having activity under an irradiation of a visible light, said method comprising treating the oxide semiconductor with a plasma of rare gas, and performing said treatment in a state substantially free from an intrusion of air into the treatment system.

54. (Amended) The method for producing a catalyst according to claim 53, wherein said state substantially free from the intrusion of air into the treatment system is a state in which a vacuum degree inside a tightly sealed system takes at least 10 minutes to make a change of 1 Torr.

55. (Amended) The method for producing a catalyst according to claim 53, wherein said oxide semiconductor is selected from the group consisting of titanium dioxide, zirconium oxide, hafnium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, and a silicon oxide-titanium oxide based complex oxide.

56. (Amended) A method for producing a catalyst comprising an oxide semiconductor having stable oxygen defects and having activity under an irradiation of visible light, comprising the step of introducing ions of a rare gas on at least a portion of the surface of the oxide semiconductor by means of ion implantation.

57. (Amended) A method for producing a catalyst having stable oxygen defects and activity under an irradiation of a visible light, comprising the step of heating an oxide semiconductor under vacuum.

58. (Amended) The method for producing a catalyst according to claim 57, wherein said oxide semiconductor is selected from the group consisting of titanium dioxide, zirconium oxide, hafnium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide, and a silicon oxide-titanium oxide based complex oxide.

59. (Amended) The method for producing a catalyst according to Claim 50, wherein said oxide semiconductor is an anatase type titanium dioxide.

61. (Amended) A method for producing a catalyst comprising an anatase type titanium dioxide having stable oxygen defects and having activity under an irradiation of a visible light, characterized by heating the anatase type titanium dioxide at a temperature of about 400° C or higher under a vacuum of about 1 Torr or lower.

62. A catalyst produced by the method of Claim 50 and having activity under the irradiation of a visible light.

63. A catalyst produced by the method of Claim 53 and having activity under the irradiation of a visible light.

64. A catalyst produced by the method of Claim 57 and having activity under the irradiation of a visible light.

71. (Amended) The catalyst according to claim 40, wherein said catalyst is in a substantially granular, thin-film, or sheet shape.

74. (Amended) A method of effecting the photo decomposition of a substance, said method comprising decomposing the substance by, under an irradiation of a light containing a visible radiation, bringing a medium containing the substance to be decomposed into contact with a catalyst comprising titanium dioxide having stable oxygen defects and exhibiting NOx oxidation activity under the irradiation of a visible light at least in the wavelength region of from about 400 nm to 600 nm.

75. (Amended) A method of effecting the photo decomposition of a substance comprising decomposing the substance by, under an irradiation of a light containing a visible radiation, bringing a medium containing the substance to be decomposed into contact with a catalyst comprising titanium dioxide having stable oxygen defects and the ratio of the peak area obtained by X-ray photoelectron spectroscopy assigned to the 1s electrons of oxygen participating in the bonds with titanium to the peak area obtained by X-ray photoelectron spectroscopy assigned to the 2p electrons of titanium (O1s/Ti2p) is 1.99 or lower.

80. (New) A method of effecting the photo decomposition of a substance comprising decomposing the substance to be decomposed by, under irradiation of a light containing a visible radiation, bringing a medium containing the substance to be decomposed

into contact with a catalyst comprising titanium dioxide having stable oxygen defects and yields a signal having a g value of from 2.003 to 2.004 in the ESR measured in darkness at 77K under vacuum, provided that the catalyst yields a signal higher in intensity than the g value of from 2.003 to 2.004 above when measured at least under the irradiation of light in the wavelength region of from 420 to 600 nm at 77K in vacuum.

81. (New) A method of effecting the photo decomposition of a substance comprising decomposing the substance to be decomposed by, under irradiation of a light containing a visible radiation, bringing a medium containing the substance to be decomposed into contact with a catalyst comprising an oxide semiconductor having stable oxygen defects and said oxide semiconductor is hafnium oxide, zirconium oxide, strontium titanate, a titanium oxide-zirconium oxide based complex oxide.

82. (New) The method according to Claim 80, wherein said substance to be decomposed is at least one substance selected from the group consisting of inorganic compounds, organic compounds, microorganisms, and tumor cells.

83. (New) The method according to Claim 81, wherein said substance to be decomposed is at least one substance selected from the group consisting of inorganic compounds, organic compounds, microorganisms, and tumor cells.

84. (New) The method according to Claim 80, wherein said medium is water.

85. (New) The method according to Claim 80, wherein said medium is air.

86. (New) The method according to Claim 81, wherein said medium is water.

87. (New) The method according to Claim 81, wherein said medium is air.